Control of American Chestnut Blight by Trunk Injection with Methyl-2-Benzimidazole Carbamate (MBC)

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ABSTRACT

Significant reduction in growth of *Endothia parasitica*, a phloem canker organism, in American chestnut trees was obtained by pressure-injecting trees with MBC (methyl-2-benzimidazole carbamate) both before and after they were artificially inoculated. Results suggest this material may be used to protect specimen, blight-susceptible chestnut trees. Benomyl [methyl-1-(butylcarbamoyl)-2-benzimidazole carbamate] in aqueous suspension was taken up slowly by the tree and it did not restrict growth of *E. parasitica*.

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Additional key words: Endothia parasitica, Castanea dentata, pressure injection, benomyl, systemic fungicide.

Benomyl applied as a soil drench has been shown to have an inhibitory effect on the growth of *Endothia parasitica* (Murr.) Anderson in bark of American chestnut trees, *Castanea dentata* Borkh. (1). Topical application of benomyl on cankers caused by the fungus was judged inadequate for control by the same authors (Anagnostakis and Jaynes, *unpublished*).

This report summarizes field tests for the control of chestnut blight by trunk injection of benomyl and MBC·HCl.

MATERIALS AND METHODS.—The trees were field grown, 6-yr-old American chestnut, approximately 3.7 cm in diam at breast height and 7.4 cm diam at 15 cm height. Benomyl (50 WP formulation) suspension and MBC·HCl solution [prepared as described by McWain and Gregory (5)] were injected into the tree trunks within 30 cm of the ground through two 9-mm diam holes drilled 5-6 cm into the wood. A Model 102-C Pressure Ir.jector from the Elm Research Institute (Harrisville, N.H.) was used at a pressure of 2.0 bars. Each treated tree received the following: Experiment I, 1.0 liter of aqueous suspension containing 2.0 g active benomyl; Experiments II and III, 1.0 liter of 0.1 N HCl containing 5.5 g MBC·HCl; and Experiment IV, 1.0 liter of 0.1 N HCl containing 20.0 g MBC·HCl. In Experiment I there were 14 trees: six control and eight treated; and in Experiments II, III, and IV there were six trees each: three control and three treated. Every tree was inoculated in three places on the north side of the stem between 1.0 and 2.0 m from the ground with a potato-dextrose agar (PDA) culture of *E. parasitica* which had been isolated a few weeks earlier from a mycelial fan on an infected native chestnut. Inoculations were made with a 6.0-mm diam cork borer. An agar plug of the same diam containing mycelium of the fungus was placed in the wound and then covered with masking tape. Visual horizontal spread of fungal growth in the cortex was measured to the nearest 1.0 mm. All inoculations and injections were made during the summer.

Tissue samples were taken from the trunks of some of the trees 8 wk and 9 mo after injection and assayed for fungitoxicity on PDA plates sown with *Penicillium* sp. spores. The samples consisted of square pieces of bark (4 mm on each side) from the four compass points taken from the trunk at a height of 0.5-2.0 m.

RESULTS AND DISCUSSION.—The aqueous suspension of benomyl injected into the trees had no noticeable effect on growth of the chestnut blight fungus (Fig. 1-Exp. I). Considerable variation was noted in time required for the suspension to be taken up by individual trees (5-24 h), and in all cases uptake of benomyl was much slower than uptake of MBC·HCl (1.5-2.0 h). The ineffectiveness of benomyl in reducing the growth of the fungus was probably the result of poor distribution of the fungicide due to plugging of vessels by the suspension as previously reported in elms (8).

There was a highly significant ($P = 0.01$) reduction in growth of the fungus on trees when MBC·HCl was injected before inoculation (Fig. 1-Exp. II, Fig. 2). Bioassay of bark from trees of Exp. II and III 8 wk after injection showed inhibition zones of from 3-11 mm in MBC·HCl-treated trees and no inhibition in untreated trees. Nine months later significant fungitoxicity could be detected in bark of some of the treated trees. In fact, a direct correlation between inhibition of fungal growth in the tree and size of the zone of inhibition was noted. In the three treated trees of Exp. II average size of the cankers after 9 mo was 12, 22, and 94 mm with zones of inhibition in the bioassay of 8, 2, and 0.3 mm respectively. Control trees had an average canker size of 105 mm and no inhibition in the bioassay. Thus not only do fungitoxic compounds remain in the bark 9 mo after treatment, but their presence is inversely correlated with the size of the canker.

When MBC·HCl was injected into trees 19 or 67 days

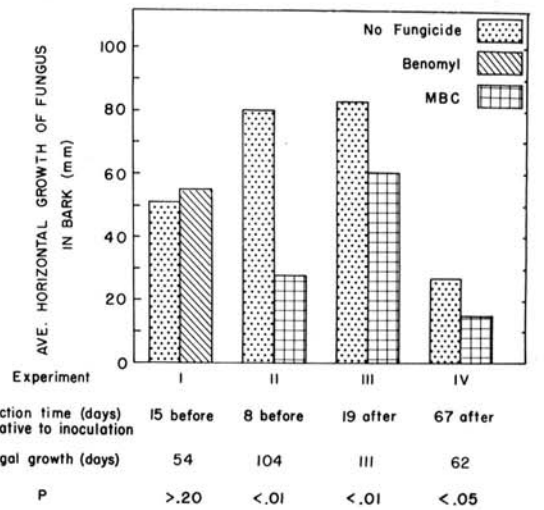

Fig. 1. Growth of *Endothia parasitica* in American chestnut seedlings pressure-injected with benomyl and MBC·HCl. Fungal growth (days) indicates length of time the fungus grew in the presence of the fungicide. Data were analyzed by analysis of variance. *P* indicates the probability that the growth of the fungus in treated trees is the same as in untreated trees.

Fig. 2-(A, B). A) Chestnut tree injected with methyl-2-benzimidazole carbamate (MBC), and **B)** control tree from experiment II 6 wk after injection. There are three inoculations on each tree. Callus is apparent in the three wounds on the MBC-injected tree, whereas tissue surrounding the wounds on the noninjected tree is hypotrophied as a result of disease spread.

after inoculation (Exp. III and IV, respectively), growth of the fungus was significantly ($P = 0.05$) less than on untreated trees (Fig. 1). The trees of Exp. IV were injected in late summer, and thus the slower growth rate of the fungus in this experiment compared to that in the other experiments is probably due to the lower prevailing mean temp.

There is a significant fungistatic effect by MBC·HCl on *E. parasitica,* reduction in fungal growth being greatest when injections precede inoculations. Complete control was observed on only one of the treated trees (Exp. II, after 9 mo), but the experimental inoculation procedure is much more severe than would be anticipated in nature. The results warrant further tests with MBC, as well as with other systemic fungicides.

Previous reports of injection of various chemicals into trees indicated that some, particularly the 8-quinolinol's, were taken up and translocated by the trees (3, 4, 7), but there was very little movement of these chemicals into the bark (7). While there have been reports of movement of MBC and similar compounds into phloem of annuals (2, 6), movement into bark of woody perennials has not previously been reported.

The reduction in growth of *E. parasitica,* a bark canker organism, by a fungicide injected into the vascular system of the tree opens new possibilities in methods of controlling similar tree diseases. The previous lack of adequate control measures for preserving even specimen chestnut trees is an indication of how difficult it has been to limit the growth of canker organisms using traditional methods.

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